

southerly). This prevailing greater roughness of the sea during winter than during summer gives the winds of the former season, the north-westerly winds, an advantage over those of the latter season, the southerly winds.

(4) The northwest winds usually have a downward component while the southern winds commonly have an upward component. The former are also more gusty than the latter, and for both reasons more disturbing to the water—more effective in starting waves.

(5) The winter northwest wind is denser, chiefly because colder, than is the southerly wind of any season, and thus through its greater momentum more likely to produce waves.

(6) Along most of the trade routes over the North Atlantic the course of the water, Gulf Stream and Drift, is from the south. Consequently the actual velocity of a given southerly wind with reference to the water, and hence its wave-producing effect, is less than that of an equal northerly wind.

There may be still other factors in favor of the northerly and north-westerly winds over the southerly winds as producers of waves, but the above are sufficient to confirm one's confidence in the observations to that effect.—F. G. T.

THE VARIABILITY OF CORRESPONDING SEASONS IN DIFFERENT YEARS.

By SIR FREDERICK STUPART, Director, Meteorological Office, Toronto.

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A problem in meteorology which still remains unsolved is why corresponding seasons in different years differ so much in character. The author notes the following conditions which lead to the distinctive features of a climatic zone: (1) Distance from the Equator; (2) geographic position in relation to land and sea; (3) altitude; (4) the prevailing winds, the outcome of a general atmospheric circulation. Inasmuch as the first three factors are practically constants in any given case, the natural assumption is that the prime cause of seasonal climatic variation must be due to variation in atmospheric circulation. The writer then contrasts the remarkably cold winter of 1917–18 with the very mild winter of 1918–19, adding the pertinent question: "Why the difference?" He then proceeds to discuss what may be termed the *normal* distribution of atmospheric pressure and shows how the pressure of the two winters noted differ from the normal.

Referring to Canada and region to the northward, he says:

In the early part of the winter of 1917–18 the anticyclonic type was more pronounced than in any other winter on record, and with most persistent areas of high barometer coming in over Yukon, perhaps indeed offshoots from the great Siberian winter anticyclone, the Northern Pacific low pressure was situated much farther south than usual and its offshoots, in the form of traveling low areas, passed into Canada over southern British Columbia and thence kept away to the southward, and the result was a prevalence of northerly winds, not only in the western Provinces but also in eastern Canada.

During the winter just closed [1919] we find conditions in strong contrast to those of the previous year; the Northern Pacific low was extremely energetic and in a stream of offshoot cyclonic areas, which impinged on the northern Alaskan coast, prevented the formation of anticyclonic conditions, and, passing first southeastward, finally moved eastward as dispersing areas across the western Provinces, there giving most persistent gradients for southerly and southwesterly winds with unseasonably high temperature.

In closing, the author believes the time is now ripe for increased investigation regarding the changes, both in the position and the temperatures of the great ocean currents. "If it can be shown," he says, "that the great Japan Current in some years carries its warm waters farther north than in other years, it may not improbably be subsequently shown that in such years cyclonic conditions are more intense near the Alaskan coast, and we shall at once have valuable information regarding the

probable distribution of barometric pressure in north-western America, and this appears to be a dominating factor in the character of our winter seasons.

"While it would appear probable that conditions that would increase the temperature and the flow of ocean currents would act simultaneously in both hemispheres, it does not necessarily follow that the effect on the northern coast of Europe would occur simultaneously with the effect on the northwest coast of America. One would surmise that as the source of the Gulf Stream is nearer the British Isles than is the source of the Japan Current to Alaska, therefore Europe would be affected before America and quite possibly this is the case. The whole question is complex but well worthy of study."—H. Lyman.

WINTERS AT NEW YORK CITY.

By J. MALCOLM BIRD.

[Notes on article "What about the old-fashioned winter?" *Scientific American*, Mar. 6, 1920, pp. 253, 261, 262, 3 figs.]

Graphs of winter snowfall, of winter average temperature, and of dates of opening and closing of navigation on rivers, for a long period, are always interesting to study, especially, since the results of such investigation recalls past snowy or cold winters and show that unusual winters are not of infrequent occurrence. The extraordinarily cold winter of 1917–18 does not stand as a marked anomaly on the temperature graph for New York City for the last 50 years, nor (except on the snowfall graph) does the mild winter of 1918–19 look so striking as it seemed. The past winter as shown by the graphs for New York City was an ordinary one.

The graph showing the duration of closed navigation on the Hudson between New York and Albany for the last 75 years is of considerable interest. The average duration of closed navigation is 101 days, from December 14 to March 25. The extremes were 140 days in 1896–97, and 0 days 1912–13, November 22 (1873), and April 29 (1897).

DISCUSSION.

The winter of 1896–97 having the longest duration of closed navigation was only a fraction of a degree below normal in temperature and had only 4 inches more than the average snowfall. This should be a caution to those who seek from ice-in-rivers statistics to draw conclusions as to the characters of winters.

The graph of winter snowfall shows a general decrease in the depth of snowfall during the last 30 years. The maximum of 76 inches in 1892–93 has been followed by snowy winters having 53 (1898–99), 57 (1904–5), 52 (1906–7), 47 (1915–16), 49 (1916–17), and 46 (1919–20). The successive minima (below 25 inches) have been 25 (1885–86), 22 (1888–89), 20 (1897–98), 20 (1899–1900), 10 (1900–1901), 23 (1905–6), 21 (1908–9), 16 (1912–13), and 4 (1918–19). Perhaps the growth of the city and the consequent increase of its effective heating of the air under the low clouds when snow is falling is responsible for this apparent decrease in snowiness. The temperature records do not give any indication of a tendency to warmer winters. In the coldest weather, when much snow is not likely to fall, the sky is usually clear and the wind strong enough to allow heating of the air by the city to have no appreciable effect on the temperature. On warm days the artificial heating of buildings is negli-